

WHAT IS CLAIMED IS:

1. An apparatus comprising:

5 a buffer comprising a plurality of entries;

a plurality of age vectors, each of the plurality of age vectors corresponding to one
or more of the plurality of entries; and

10 a control circuit coupled to the buffer, wherein the control circuit is configured,
responsive to data being provided to the buffer to be written to at least a
first entry of the plurality of entries, to generate a first age vector of the
plurality of age vectors, the first age vector corresponding to at least the
first entry, wherein the first age vector is indicative of which of the
plurality of entries contain data that is older than the data being written to
at least the first entry, and wherein the control circuit is configured to

15 select a selected entry of the plurality of entries for reading responsive to
the plurality of age vectors, the selected entry being the entry of the
plurality of entries that: (i) has an attribute used to select the selected
entry, and (ii) other entries indicated as storing older data in the age vector

20 corresponding to the selected entry do not have the attribute.

2. The apparatus as recited in claim 1 wherein the control circuit is configured to select
the selected entry responsive to the selected entry having the attribute and further

25 responsive to no other entries of the plurality of entries that are indicated as older by the
age vector corresponding to the selected entry having the attribute.

3. The apparatus as recited in claim 2 wherein the control circuit comprises circuitry
coupled to receive an indication of the attribute from each entry of the plurality of entries

and to receive the plurality of age vectors, and wherein the circuitry is configured to generate the selection of the selected entry responsive to the indication of the selected entry indicating the attribute and responsive to the indications from other entries indicated as older than the selected entry in the age vector corresponding to the selected entry
5 indicating that the other entries do not have the attribute.

4. The apparatus as recited in claim 1 wherein the plurality of entries are grouped into a plurality of non-overlapping groups, at least two entries included in each group, and wherein each of the plurality of age vectors corresponds to a different one of the plurality
10 of groups, and wherein the age vector corresponding to a first group of the plurality of groups indicates which of the other groups of the plurality of groups contain data that is older than the data in the first group.

15 5. The apparatus as recited in claim 1 wherein each of the plurality of entries has a different age vector.

6. The apparatus as recited in claim 1 wherein each of the plurality of age vectors comprises a plurality of indications, each indication corresponding to a different entry or entries of the plurality of entries.

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7. The apparatus as recited in claim 6 wherein the control circuit generating the first age vector includes the control circuit being configured to: (i) set each of the plurality of indications in the first age vector that corresponds to an entry or entries that contain valid data to a first state indicating older, and (ii) set each of the plurality of indications in the
25 first age vector that corresponds to an entry or entries not containing valid data to a second state indicating newer.

8. The apparatus as recited in claim 7 wherein the control circuit, responsive to data in an entry or entries being deleted from the buffer, is configured to set the corresponding one

of the plurality of indications in each of the plurality of age vectors to the second state.

9. The apparatus as recited in claim 6 wherein the control circuit generating the first age vector includes the control circuit being configured to set each of the plurality of 5 indications in the first age vector to a first state indicating older.

10. The apparatus as recited in claim 9 wherein the control circuit is configured, responsive to data being written into an entry or entries of the buffer, to set the corresponding one of the plurality of indications to a second state indicating newer in 10 each of the plurality of age vectors.

11. A method comprising:

receiving data to be written to at least a first entry of a plurality of entries in a 15 buffer;

generating a first age vector of a plurality of age vectors responsive to receiving the data, each of the plurality of age vectors corresponding to one or more of the plurality of entries, the first age vector corresponding to at least the 20 first entry, and wherein the first age vector is indicative of which of the plurality of entries contain data that is older than the data being written to at least the first entry; and

selecting a selected entry of the plurality of entries for reading responsive to the 25 plurality of age vectors, the selected entry being the entry of the plurality of entries that: (i) has an attribute used to select the selected entry, and (ii) other entries indicated as storing older data in the age vector corresponding to the selected entry do not have the attribute.

12. The method as recited in claim 11 wherein selecting the selected entry is responsive to the selected entry having the attribute and further responsive to no other entries of the plurality of entries that are indicated as older by the age vector corresponding to the selected entry having the attribute.

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13. The method as recited in claim 11 wherein the plurality of entries are grouped into a plurality of non-overlapping groups, at least two entries included in each group, and wherein each of the plurality of age vectors corresponds to a different one of the plurality of groups, and wherein the age vector corresponding to a first group of the plurality of groups indicates which of the other groups of the plurality of groups contain data that is older than the data in the first group.

14. The method as recited in claim 11 wherein each of the plurality of entries has a different age vector.

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15. The method as recited in claim 11 wherein each of the plurality of age vectors comprises a plurality of indications, each indication corresponding to a different entry or entries of the plurality of entries.

20 16. The method as recited in claim 15 wherein generating the first age vector comprises:

setting each of the plurality of indications in the first age vector that corresponds to an entry or entries that contain valid data to a first state indicating older; and

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setting each of the plurality of indications in the first age vector that corresponds to an entry or entries not containing valid data to a second state indicating newer.

17. The method as recited in claim 16 further comprising, responsive to data in an entry or entries being deleted from the buffer, setting the corresponding one of the plurality of indications in each of the plurality of age vectors to the second state.

5 18. The method as recited in claim 15 wherein generating the first age vector comprises setting each of the plurality of indications in the first age vector to a first state indicating older.

19. The method as recited in claim 18 further comprising, responsive to data being written into an entry or entries of the buffer, setting the corresponding one of the plurality of indications to a second state indicating newer in each of the plurality of age vectors.

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20. A processor comprising one or more circular buffers, each of the circular buffers comprising:

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 a buffer comprising a plurality of entries;

 a plurality of age vectors, each of the plurality of age vectors corresponding to one or more of the plurality of entries; and

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 a control circuit coupled to the buffer, wherein the control circuit is configured, responsive to data being provided to the buffer to be written to at least a first entry of the plurality of entries, to generate a first age vector of the plurality of age vectors, the first age vector corresponding to at least the first entry, wherein the first age vector is indicative of which of the plurality of entries contain data that is older than the data being written to at least the first entry, and wherein the control circuit is configured to select a selected entry of the plurality of entries for reading responsive to the plurality of age vectors, the selected entry being the entry of the

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plurality of entries that: (i) has an attribute used to select the selected entry, and (ii) other entries indicated as storing older data in the age vector corresponding to the selected entry do not have the attribute.

- 5 21. The processor as recited in claim 20, wherein the one or more circular buffers include at least one circular buffer implemented in a scheduler, the data stored in each entry comprising operations to be executed by one or more execution cores in the processor.
- 10 22. The processor as recited in claim 20, wherein the one or more circular buffers include at least one circular buffer implemented in a retire queue.
23. The processor as recited in claim 20, wherein the one or more circular buffers include at least one circular buffer implemented as a load/store buffer storing load/store operations.